

SECTION XXXXXX – TECHNICAL SPECIFICATIONS FOR INSTALLATION OF
HYBRID CEMENT AND GEOPOLYMER LININGS FOR MANHOLES, WETWELLS,
AND OTHER SANITARY SEWER STRUCTURES

1.00 PART 1 -- GENERAL

1.01 SCOPE

- A. It is the intent of this contract to install a hybrid cement or geopolymer lining system to the walls, of all manholes and the specified surfaces of other structures. This specification covers work, materials, equipment and tools including specially developed application equipment as required for installation of a field applied unique monolithic interior surfacing system. The use of specialized equipment combined with rigorous surface preparation requirements shall be used to apply the products without the use of solvents. The equipment adds high heat and pressure to the monolithic surfacing system resulting in a high build and quick set of the completed system. Product application requirements and procedures described herein include surface preparation, mixing application, material handling and storage, qualification of the applicator and application quality control.

1.02 PRE-QUALIFICATION OF PRODUCTS AND INSTALLERS

- A. The Owner will only approve experienced installers utilizing proven Commercially Acceptable sewer rehabilitation products. In order to be considered Commercially Acceptable, the Product and Installer must demonstrate compliance with the following requirements.
- B. Bid proposals must be labeled clearly on the outside of the bid envelope, defining the product(s) and installer being proposed. Only bids using pre-approved products and installers will be opened and read. Bids submitted on products or from installers that have not been pre-approved will be returned unopened.
- C. The following products and installers are classified Commercially Acceptable and are pre-approved for use on this project:
1. Portland Cement Products
 - a. QM-1s Restore® by Quadex, LLC (Vortex Companies); Suncoast Infrastructure, Inc.
 - b. MS-2®A by The Strong Company, Inc.; Pre-Approved Installer
 2. Calcium Aluminate Products
 - a. AluminaLiner® by Quadex, LLC (Vortex Companies); Suncoast Infrastructure, Inc.
 - b. MS-2®C by The Strong Company, Inc.; Pre-Approved Installer
 3. Geopolymer Products

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- a. GeoKrete® by Quadex, LLC (Vortex Companies); Suncoast Infrastructure, Inc.
 - b. GeoSpray® by Geo Tree Solutions; Pre-Approved Equal
- B. Documentation for other products and installers seeking pre-approved status must be submitted to the Engineer no less than two (2) weeks prior to bid date to ensure adequate consideration.
- C. Pre-approval of products and installers shall be classified as Commercially Acceptable. To be considered Commercially Acceptable, the product and the installer must demonstrate full compliance with the requirements outlined below. Only products and installers deemed Commercially Acceptable will be allowed to bid as specified.
- D. All additional products and installers that are pre-approved by the Engineer shall be identified in an addendum issued prior to the bid date.
1. For a PRODUCT to be considered Commercially Acceptable, the Manufacture shall document the successful installation of a minimum of 500,000 square feet of successful wastewater collection system installations in the U.S, using the PRODUCT. Also, the PRODUCT shall have been in service within the wastewater collection system of the Owner (or some other city, town, or county within the United States of America) for a minimum of twenty (20) years.
 2. For an INSTALLER to be considered as Commercially Acceptable, the INSTALLER must satisfy all insurance, financial, and bonding requirements of the Owner, be trained and certified by the Manufacturer, and must have had at least five (5) years active experience in the commercial installation of the hybrid cement and geopolymer products.
 3. If a proposed INSTALLER does not meet the years of experience or the installation history requirements, the proposed INSTALLER, at the Engineer's request, may make arrangements for the manufacturer to provide a representative to periodically inspect the installation to confirm the product is installed in accordance with the manufacturer's requirements.
- E. The condition of the structures to receive the protective coating will be classified in accordance with the following criteria:

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Condition	Description
New	New structures or structures that have not been exposed to sanitary sewer. No evidence of infiltration.
A	Minimal damage. Minimal evidence of exposure to sanitary sewer gases. No evidence of infiltration.
B	Moderate damage such as missing mortar between bricks in brick manholes, some exposed aggregates in concrete structures. Moderate evidence of exposure to sanitary sewer gases. Evidence of minimal infiltration.
C	Severe damage such as missing bricks in brick manholes, severe exposed aggregates or exposed reinforcing steel in concrete structures. Severe evidence of exposure to sewer gases. Evidence of moderate infiltration.

F. The minimum coating thickness shall be as described in the following table:

Type of Structure	Condition	Minimum Liner Thickness (inches)
Manhole (precast)	A	1/2"
Manhole (brick)	A	1/2"
Manhole (precast)	B	3/4"
Manhole (brick)	B	3/4"
Manhole (precast)	C	1"
Manhole (brick)	C	1"
Wetwell or Lift Station	New	1/2"
Wetwell or Lift Station	A	1/2"
Wetwell or Lift Station	B	3/4"
Wetwell or Lift Station	C	1"

1.02 The following summary lists the material to be used for various sulfide conditions in a municipal sanitary sewer system:

- A. No evidence of sulfide conditions – Portland Cement based material
- B. Mild sulfide conditions (pH 2.0 or higher) – Calcium Aluminate based material
- C. Severe sulfide conditions (pH 1.0 or higher) – Geopolymer based material.

1.03 REFERENCES

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- A. The following standards are hereby incorporated into these specifications by reference:
 - 1. ASTM C109 – Compressive Strength
 - 2. ASTM C882 – Bond Strength
 - 3. ASTM C596 – Drying Shrinkage
 - 4. ASTM C138 – Wet Unit Weight
 - 5. ASTM C403 – Set Time
 - 6. ASTM C267 – Sulfate Resistance
 - 7. ASTM C666 – Freeze/Thaw Resistance
 - 8. ASTM C234 – Pull Out Strength
 - 9. ASTM – The published standards of the American Society for Testing and Materials, West Conshohocken, PA.
 - 10. NACE – The published standards of the National Association of Corrosion Engineers (NACE International), Houston, TX.

1.04 SUBMITTALS

- A. All submittals shall be submitted in accordance with the applicable portions of these specifications.
- B. The Contractor shall submit the following information to the Engineer for approval prior to beginning the installation of the protective coating.
 - 1. Manufactures data sheets for the lining materials
 - 2. Third party test results verifying the physical properties of the lining materials meet or exceed the requirements of these specifications.
 - 3. Applicator’s procedures for preparing the surface of the structure and installing the lining system.
 - 4. Documentation that the Applicator of the lining system has been trained and certified by the Manufacturer and meets the experience requirements of these specifications.

2.00 PART 2 – PRODUCTS

2.01 The coating system shall be a spray-applied, trowel applied, or spun-cast hybrid cement or geopolymer lining system for use in coating new or existing manholes, wet wells, lift stations, treatment plants, and other structures. All products to be used on this project must be pre-approved by the Engineer prior to the bid date.

2.02 In order to be considered as an equal, a product must have the following minimum physical characteristics as measured by the applicable ASTM Standards referenced herein.

- A. Portland Cement or Calcium Aluminate
 - 1. Minimum Compressive Strength 9,000 psi
 - 2. Freeze-Thaw No Visible damage after 300 cycles
 - 3. Shrinkage 0% at 28 days
- B. Geopolymer

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| 1. | Minimum Compressive Strength | 8,000 psi |
| 2. | Freeze-Thaw | No Visible damage after 300 cycles |
| 3. | Shrinkage | <0.02% |

2.03 Other manufactures or products seeking pre-approval must submit the following documentation to the Engineer a minimum of two weeks prior to bid date. This time frame allows the Engineer ample time to determine if the proposed product is an acceptable alternative.

- A. Documentation that the proposed Product meets the above minimum physical characteristics including results of testing performed by a bonded, third party testing company.
- B. An affidavit attesting to the successful use of the Product as a protective coating for concrete or masonry structures for a minimum continuous period of five (5) years in wastewater conditions recognized as corrosive or otherwise detrimental to concrete and masonry.
- C. A verifiable list of references that document the successful installation and use of the Product in a minimum of 750,000 square feet of sanitary sewer structures.

3.00 PART 3 – EXECUTION

3.01 INSTALLER QUALIFICATIONS

- A. All products must be installed by an Installer that has been trained and certified by the manufacturer.
- B. The Installer must provide verifiable documentation of the above certification and the successful installation of 250,000 square feet of the pre approved Product in sanitary sewer structures.

3.02 QUALITY ASSURANCE

- A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM standards.
- B. Applicator shall use an adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts. These workmen shall be completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- C. Applicator shall use approved specialty equipment adequate in size, capacity and number sufficient to accomplish the work of this Section in a timely manner.

3.03 SAFETY

- A. Applicator shall perform his work in a manner to protect the health and safety of all workmen and the public.

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- B. All work shall be in accordance with standard industry safety practices.
- C. All work, including entry into confined spaces shall be performed in strict compliance with current OSHA regulations.

3.04 PRE-COAT INSPECTION

- A. The applicator's vehicles and equipment must be able to access the structures to be coated under their own power.
- B. Active flows shall be dammed, plugged or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated.
- C. Installation of the protective coating shall not commence on any surfaces containing freshly poured concrete until the concrete substrate has properly cured, and in no case less than 28 days.

3.05 SURFACE PREPARATION

- A. Applicator shall inspect all surfaces specified to receive the monolithic surfacing system prior to surface preparation. Applicator shall promptly notify Owner of any noticeable disparity in the surfaces that may interfere with the proper preparation or application of the monolithic surfacing system.
- B. All concrete that is not sound or has been damaged by chemical exposure shall be restored to a sound concrete surface. All contaminants including all oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.
- C. Surfaces to receive lining shall be cleaned to produce a sound concrete or masonry surface with adequate profile and porosity to provide a strong bond between the lining system and the substrate. Surface preparation methods shall be based upon the conditions of the substrate and the requirements of the lining system to be applied, but as a minimum, shall be in accordance with the procedures listed below.
 - 1. Clean all surfaces with high pressure water to remove all loose or contaminated debris. Other equipment and methods may be required to remove all unsound material.
 - 2. Active water infiltration shall be stopped by using a cementitious water plug that is compatible and suitable for top coating with the specified monolithic surfacing system.
 - 3. If pre-installation inspection reveals severe infiltration (defined as visible and consistent movement of water) through the wall of the structure, a collapse in an area of the wall, a bench that needs to be rebuilt/repared, the contractor will advise the Owner's representative. Such extra work will be approved in writing between the Owner and the contractor prior to the commencement of the work and shall be considered as a separate pay item.

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D. APPLICATION

1. For each bag of product, use the amount of water required per manufacturer's recommendations following mixing procedures noted on product bag using only enough water to produce a mix consistency to allow application of liner material up to one (1) inch thick in a single application without material "sagging" on vertical surface and using the approved equipment for mixing and application.
2. Prepared mix shall be discharged into a hopper and another batch prepared to occur in such a manner as to allow spraying continuously without interruption until each application is complete.
3. The substrate shall be clean and free of all foreign material and shall be damp without noticeable free water droplets or running water prior to the application of liner material. Liner material shall be applied up to 1 inch thick in one or more passes starting from the bottom of the frame; however, minimum total thickness shall not be less than 1/2 inch. The surface shall then be firmly troweled to a smooth finish being careful not to over trowel. A wet brush finish shall be applied to the trowel-finished surface.
4. Manufacturer's recommendations shall be followed whenever more than 24 hours have elapsed between applications.
5. The covers shall be removed at this time and the bench sprayed with liner material as mixed per specifications (4.3) and spray applied in such a manner that a gradual slope is produced from the walls to the invert with the thickness at the invert to be no less than 1/2 inch. The wall/bench intersection shall be rounded to a uniform radius the full circumference of the intersection.
6. Caution shall be taken to minimize exposure of applied liner material to sunlight and air movement. If time between applications of additional passes is to be longer than 15 minutes, the structure shall be covered. The structure shall not be exposed to sunlight or air movement for longer than 15 minutes before covering or closing access. In extremely hot and arid climates, the structure shall be shaded during application. The liner material shall be kept damp for the first 72 hours if humidity levels are below 70%. A curing compound conforming to ASTM C309 may be used in lieu of keeping the liner material damp if a polymeric topcoat will not be applied. Follow manufacturer's recommendations while applying curing compound.
7. No application shall be made if ambient temperature is below 40 degrees Fahrenheit. No application shall be made to frozen substrates or if the substrate is expected to freeze within 24 hours after application.
8. Precautions shall be taken to keep the mix temperature at time of application below 90 degrees Fahrenheit. Water temperature shall not exceed 80 degrees Fahrenheit. Chill with ice if necessary.

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9. Four 2 inch cube specimens shall be cast each day or from every pallet of liner material used, whichever occurs first. Specimens shall be properly packaged, labeled, and returned to manufacturer for testing in accordance with the owner's or manufacturer's directions for compression strength per ASTM C109.

E. QUALITY ASSURANCE

1. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM standards.
2. Applicator shall use an adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts. These workmen shall be completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
3. Applicator shall use approved specialty equipment adequate in size, capacity and number sufficient to accomplish the work of this Section in a timely manner.

F. TESTING AND INSPECTION

1. Four 2 inch cube specimens shall be cast each day or from every pallet of liner material used, whichever occurs first. Specimens shall be properly packaged, labeled, and returned to manufacturer for testing in accordance with the owner's or manufacturer's directions for compression strength per ASTM C109.
2. The Engineer and Applicator shall make a final visual inspection. Any deficiencies in the finished system shall be marked and repaired according to the procedures set forth herein by Applicator.

4.00 PART 5 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

- A. Measurement for new and rehabilitated manholes shall be per square foot for all surfaces receiving the lining.
- B. Measurement for new and rehabilitated wet wells, pump stations, and other structures shall be per square foot and shall be measured as the total area that receives the lining.

4.02 PAYMENT

A. PAYMENT

Payment will be made under:

New (Precast) Manhole Rehabilitation - per SF

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Type A (Precast) Manhole Rehabilitation	- per SF
Type B (Precast) Manhole Rehabilitation	- per SF